Oyster Restoration
Pre-construction Site Assessment of the
Manokin River Sanctuary

Prepared by Oyster Recovery Partnership for Maryland Department of Natural Resources

MOU# 605P7400192

December 2019

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Introduction

As part of the 2014 Chesapeake Bay Watershed Agreement, Maryland committed to restoring oyster populations in five tributaries in Maryland's portion of the Chesapeake Bay by 2025. The fifth tributary selected for restoration within Maryland's waters is the Manokin River. This tributary is located on the lower eastern portion of Maryland's Chesapeake Bay and has been closed to wild commercial harvest since 2010. The mouth of the river empties into Tangier Sound and this area has historically exhibited strong oyster recruitment.

The Maryland Interagency Workgroup (hereafter Workgroup), tasked with overseeing the restoration of the tributary, used data from Maryland Department of Natural Resources (DNR) patent tong surveys conducted in 2012, 2015, 2017 and 2018 to determine the status of the oyster populations on habitat within the sanctuary. The National Oceanic and Atmospheric Administration (NOAA) completed additional GIS analysis to classify the condition and distribution of oyster habitat, and this information was used to determine initial restoration construction areas: premet (defined as already meeting density and biomass targets), seed-only, and substrate and seed. Premet reefs were estimated to be 20 acres, seed-only restoration reefs were estimated to be 305 acres, and substrate and seed restoration reefs were estimated to be 438 acres (Table 1).

The accuracy of pre-classified habitats is assessed through ground-truthing using patent tongs. Therefore, the goal of this survey was to collect patent tong data to evaluate all habitats and determine the final classification for planning of planting in 2020 and beyond. In fall of 2019, a systematic patent tong survey was used to evaluate roughly 75 acres of habitat. Additional surveys will take place over the next several years, encompassing between 401 to 763 acres.

TABLE 1. THE GENERAL GUIDELINES FOR DETERMINING THE MOST APPROPRIATE TYPE OF RESTORATION.

	General Premet Criteria	General Seed-Only Criteria	General Substrate and Seed Restoration Criteria
Depth	4-20 ft	4-20 ft	7-20 ft
Bottom Type	on shell dominant bottom, sand, sand & shell, muddy sand, muddy sand & shell, sandy mud, and sandy mud & shell (not on shell dominant bottom) also on hard subsurface sediments identified by sub-bottom profiling sonar	on shell dominant bottom	sand, sand & shell, muddy sand, muddy sand & shell, sandy mud, and sandy mud & shell (not on shell dominant bottom). also on hard subsurface sediments identified by sub-bottom profiling sonar
Oyster Density	> 50 per m^2 (also oyster biomass > 50 g per m^2)	<50 per m^2	< 5 per m^2
Lease Proximity	Not within 150 ft of leases	Not within 150 ft of leases	Not within 150 ft of leases
Navigation Aid Proximity	Not within 250 ft of navigation aids	Not within 250 ft of navigation aids	Not within 250 ft. of navigation aids
Dock Proximity	Not within 50 ft of private docks	Not within 50 ft of private docks	Not within 250 ft. of private docks
SAV Proximity	No intersection with SAV beds	No intersection with SAV beds	No intersection with SAV beds

This report details the methods and results for the first round of pre-construction habitat assessment.

Methods

Ten days of sampling were conducted in September and October 2019 aboard a contracted vessel, the F/V *Billie Jean.* After conversations with DNR staff, seven sites were chosen for the first round of surveys (Table 2). Project partners wanted to focus on sites in the 7-20ft depth range, and sites that would allow for at least 50 acres of seeding in spring 2020. Additionally, areas located near sites classified as needing substrate and seed restoration with little existing patent tong data were targeted.

TABLE 2. SEED-ONLY SITES DESIGNATED FOR THE FIRST ROUND OF MANOKIN SANCTUARY PRE-CONSTRUCTION SURVEYS. PATENT TONG DATA COMES FROM DNR SURVEYS OVER THE PERIOD OF 2012-18.

Site ID	Area (acres)	Patent Tong bottom type	CMECS Classification
SO_11	51.7	Mud shell grit	Biogenic oyster rubble, mud
SO_25	3.7	Mud sand	Biogenic oyster rubble, sand
SO_26	4.7	Mud	Biogenic oyster reef, mud
SO_28	5.7	N/A	Biogenic oyster rubble
SO_29	5.1	Mud sand	Anthropogenic shell
SO_34	1.9	Mud	Biogenic oyster
SO_35	2.3	N/A	Biogenic oyster rubble, mud

The methods implemented during the Manokin Sanctuary surveys are similar to the Upper St. Mary's River Oyster Restoration Tributary Plan (ORP 2019). Assessment protocols require fine-scale resolution information to determine whether benthic habitats are suitable for oyster population growth. For the first round of pre-construction surveys, a 25 x 25m grid was created in ArcGIS (ESRI ArcMap version 10.7.1) and overlaid on the target sites (Figure 1). When creating sample grids on irregularly shaped polygons, some resulting cells are too small or too narrow to sampled effectively. In this case, cells under $250m^2$ were removed. ORP staff then created target sample points in the centroid of each grid cell. Future analysis will be conducted to determine if a 35 x 35 m grid or 50 x 50 m grid could be utilized in future surveys to increase efficiency while producing the same results.
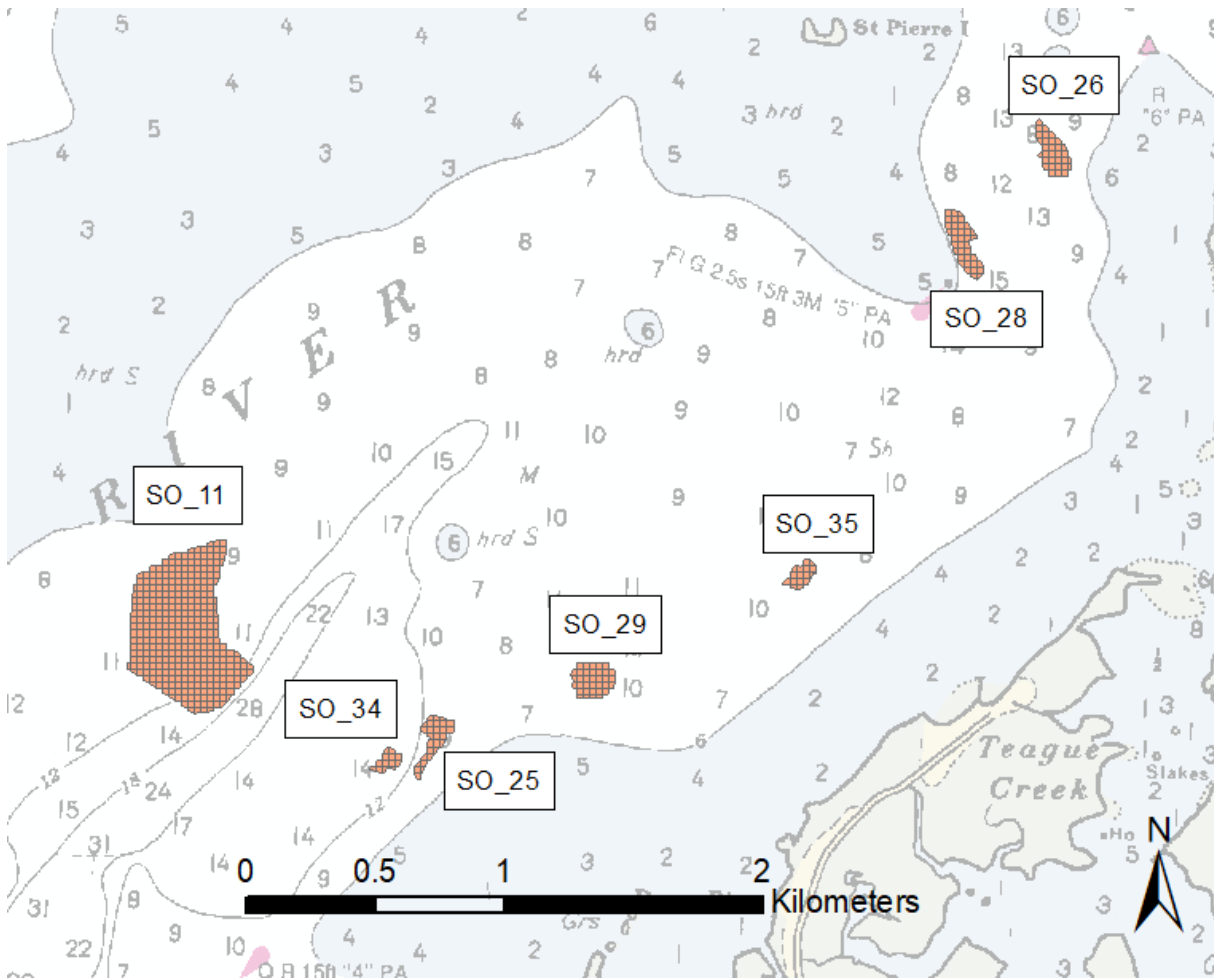
FIGURE 1. SITES CHOSEN FOR FIRST ROUND OF GROUNDTRUTHING IN MANOKIN SANCTUARY, WITH 25 X 25M GRID APPLIED.

During the fall 2019 survey, habitats were sampled using patent tongs, a specialized commercial fishing gear used to harvest oysters. Patent tongs function much like a benthic grab and are well suited to quantify the condition of benthic habitat through the retrieval of the sediment surface layer which could include oysters, shell, or other sediment features. The coordinates of each patent-tong sample were collected when the patent tongs reached the sediment surface. A Differential Global Positioning System (DGPS) antenna was positioned adjacent to the location where the patent tongs were deployed so no position offset was required. Aboard the *Billie Jean*, the patent tongs sampled 1.875m². Several qualitative measurements were made once each grab was brought to the surface, including the depth of sediment covering shell (Surface Sediment), the percent of shell not covered by sediment (Exposed Shell), and the amount of material in the sample (Patent Tong Fullness). The substrate composition was recorded based on observations of the sample during sorting and processing. At least 30 live oysters are measured and all remaining oysters and boxes were enumerated.

Two analytical approaches were used to assess the data. The first approach determines whether a site needs restoration based on the abundance and biomass of oysters currently on the site, while the second approach used an index of habitat quality to determine whether a site is suitable for restoration and the type of restoration required. An index of habitat quality was

developed to determine whether oyster habitat was suitable for seed-only restoration, substrate and seed restoration, or not suitable for either (e.g. an area consisting of all mud that cannot support restoration). Six benthic habitat components observed from samples were used to develop the index:

1. Exposed Shell
2. Primary Substrate and Secondary Substrate
3. Surface Sediment
4. Number of Live Oysters
5. Surface Shell, calculated as (Total shell volume x percent gray shell) – total shell volume
6. Oyster density and biomass data

The first five benthic components are given a binary score expressed as a 1 or 0, with a result of 1 suitable for restoration construction and 0 being unsuitable (Table 3).

TABLE 3. FIVE BENTHIC HABITAT COMPONENTS USED TO DEVELOP THE INDEX OF HABITAT QUALITY AND THE CRITERIA USED TO ESTABLISH A BINARY SCORE FOR EACH COMPONENT.

Benthic Component	Suitable for Oysters
Exposed Shell	Shell 50% exposed or greater
Bottom Type	Oyster, loose shell, or shell hash
Surface Sediment	Less than 5 cm
Number of Live Oysters	Greater than 5 oysters per square meter
Surface Shell Volume	Greater than 10 liters per square meter

A final habitat suitability score for each grid cell is calculated as the sum of each benthic component score at the individual grid cell using the equation:

$$Habitat\ Suitability\ Score = S1 + S2 + S3 + S4 + S5$$

Where S1 = Exposed Shell Score, S2 = Bottom Type Score, S3 = Surface Sediment Score, S4 = Number of Live Oysters Score, and S5 = Surface Shell Volume Score. The result of habitat suitability scores will determine whether a sampling grid cell is suitable for restoration construction based on a ranking between zero and five. Ranks of one or two are suitable for substrate and seed restoration, ranks of three require additional review, and ranks of four and five are suitable for seed-only restoration. A rank of zero is considered unsuitable for restoration.

The oyster density and biomass data assessment for each grid will be evaluated over the entire reef and if both density and biomass are greater than 50 oysters per m^2 and 50 grams per m^2, the reef will be considered premet.

Results

Over 500 patent tong grabs were collected during the first round of Manokin Sanctuary sampling (Table 4). All size classes of oysters were observed, from spat to over 150mm (Figure 2).

| Site ID	Dominant Substrate Type	Average Live Density (per m^2)	SD Live Oyster Density	Average Total Volume (L/m^2)	SD Volume	Samples taken (N)	% of Cells Scoring 4 or 5
SO_11	Loose shell	14.55	12.09	5.86	2.74	340	74.1
SO_25	Shell hash	2.65	3.75	3.52	2.22	28	14.3
SO_26	Loose shell	4.35	2.69	4.13	1.46	32	34.4
SO_28	Loose shell	4.77	7.05	3.21	1.86	37	21.6
SO_29	Loose shell	12.49	11.06	4.66	2.94	35	62.9
SO_34	Mud	6.07	9.14	3.11	3.37	13	23.1
SO_35	Mud	1.53	1.76	2.73	0.87	16	6.3

Manokin 2019 Survey
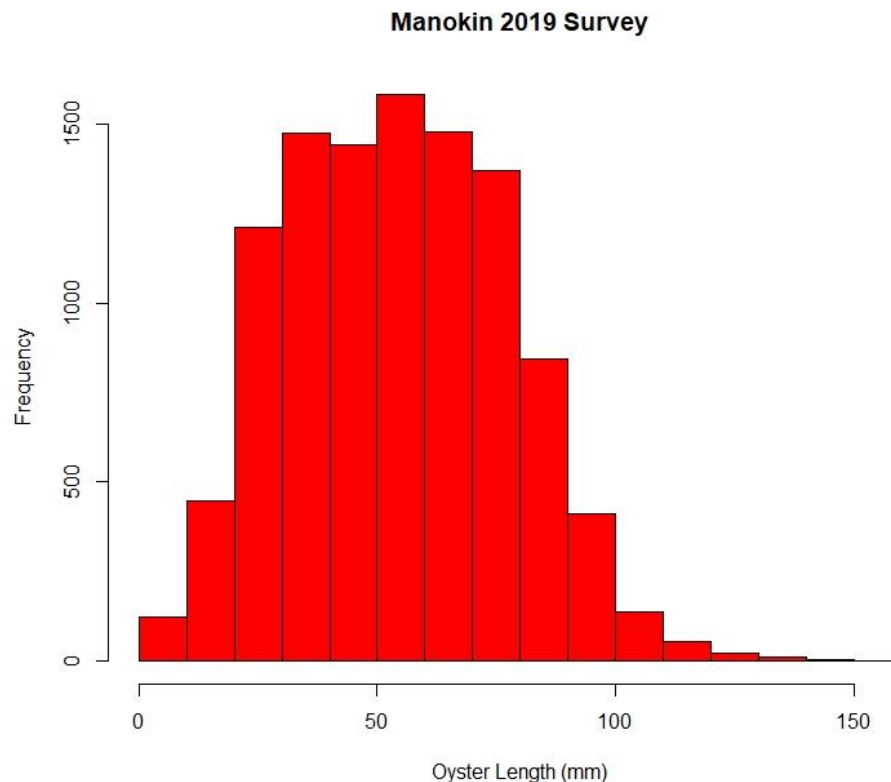
FIGURE 2. LENGTH-FREQUENCY HISTOGRAM FOR ALL OYSTERS MEASURED IN MANOKIN SANCTUARY DURING FALL 2019 GROUNDTRUTHING SURVEY.

Based on patent tong samples, no sites were classified as premet, meaning no areas displayed live oyster density greater than or equal to 50 oysters/m^2 and live oyster biomass greater than or equal to 50 g/m^2. SO_11 had the most samples meeting seed-only restoration requirements, with nearly three-quarters of cells scoring a four or five. It also had the highest density of live oysters per square meter. This site is recommended for seed-only treatment, with perhaps a

slight change in reef boundary to remove the northeast corner (Figure 3). SO_25 and SO_35 had the lowest density of live oysters of the sites sampled.
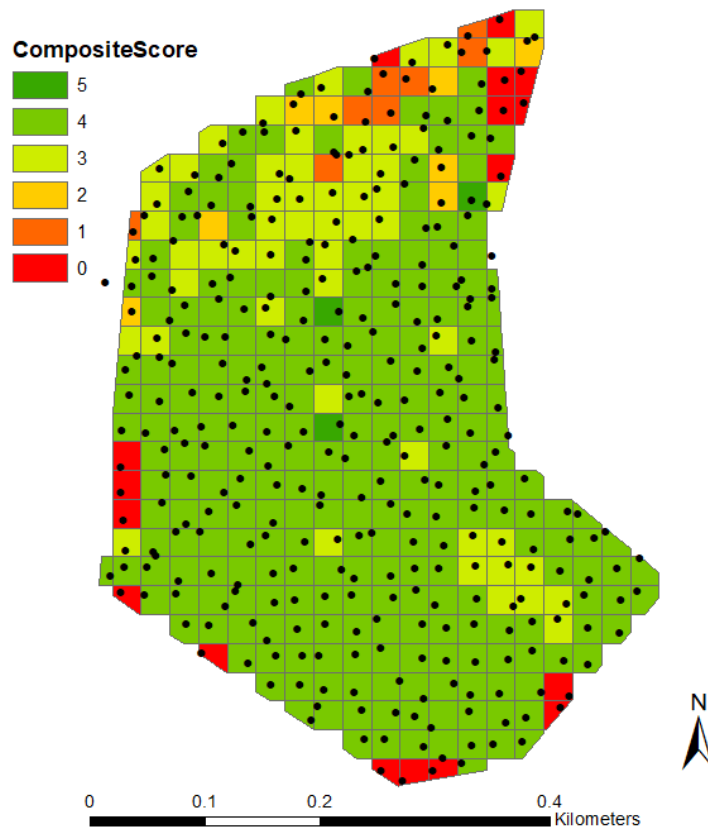
SO_34 and SO_25 will likely require substrate and seed restoration (Figure 4). While SO_34 did not display the lowest live oyster density of areas sampled, the primary substrate found was mud. Such soft sediments are not ideal for seed-only restoration, as oysters would likely sink into the sediment.
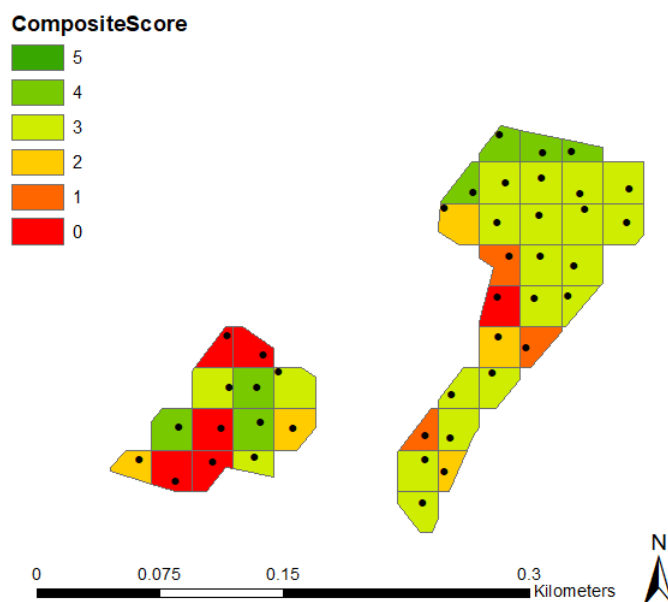
FIGURE 4. COMPOSITE SCORES FOR EACH GRID CELL OF SO_34 (LEFT) AND SO_25 (RIGHT). BLACK DOTS REPRESENT ACTUAL LOCATIONS OF PATENT TONG GRABS.

After SO_11, SO_29 had the highest proportion of samples scoring four or five, meaning it is also suitable for seed-only restoration (Figure 5).
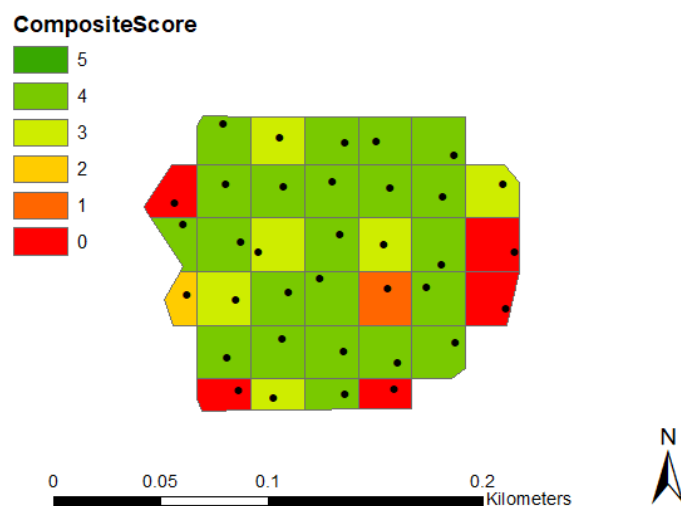

FIGURE 5. COMPOSITE SCORES FOR EACH GRID CELL OF SO_29. BLACK DOTS REPRESENT ACTUAL LOCATIONS OF PATENT TONG GRABS.

SO_35 likely requires substrate addition before seeding (Figure 6). This site had both the lowest average volume of material and lowest density of live oysters per square meter.
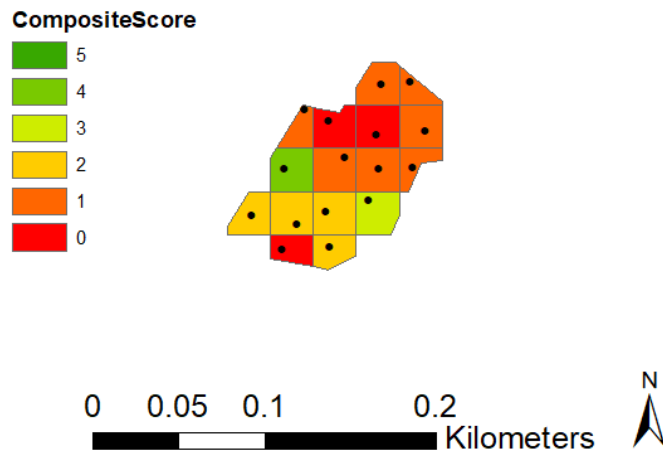
FIGURE 6. COMPOSITE SCORES FOR EACH GRID CELL OF SO_35. BLACK DOTS REPRESENT ACTUAL LOCATIONS OF PATENT TONG GRABS.

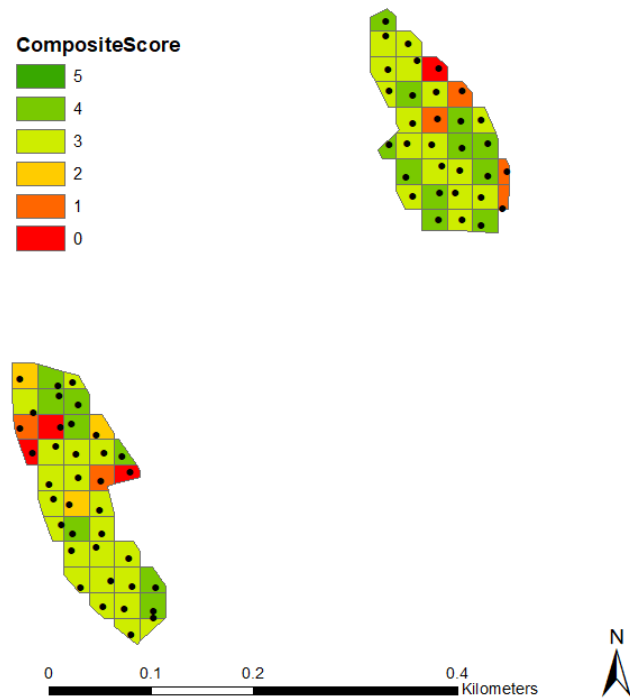SO_28 and SO_26 may need further review, as both had many samples with a composite score of three (Figure 7).

FIGURE 7. COMPOSITE SCORES FOR EACH GRID CELL OF SO_28 (LEFT) AND SO_26 (RIGHT). BLACK DOTS REPRESENT ACTUAL LOCATIONS OF PATENT TONG GRABS.

Conclusions

This first round of ground-truthing in the Manokin River Sanctuary encompassed approximately 75 acres. As expected, the reefs surveyed had a patchy distribution of oysters. The goal of this survey was to groundtruth previously classified habitats to better inform restoration. Going forward, we recommend using a systematic patent tong survey to collect data in areas that have not been monitored in recent years to ensure the best type of restoration treatment is applied.